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ROOT DISEASES OF CEREALS

by

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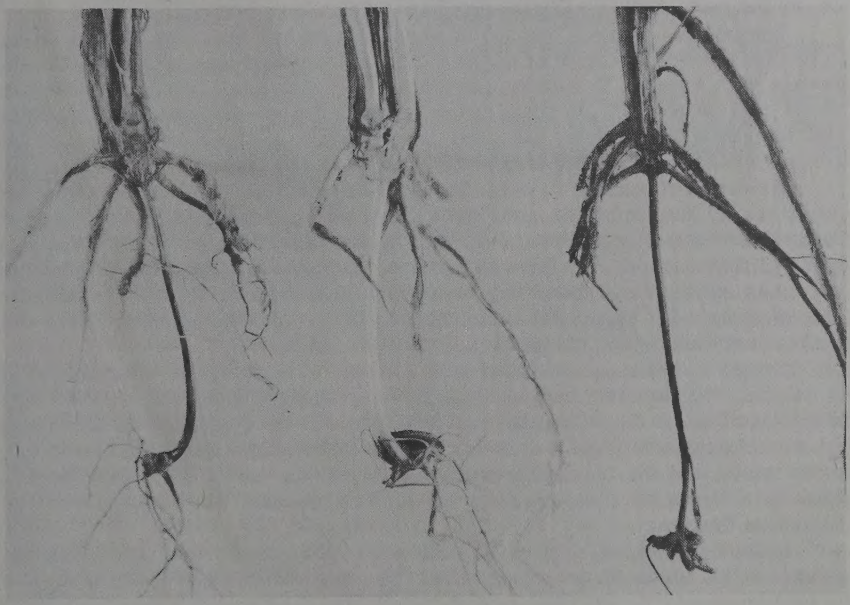

The lower part of three wheat plants, showing on the left common root rot, on the right take-all root rot, and a healthy plant in the center. Observe in common root rot the decayed crown and crown roots and lesions on the stem below the crown. The take-all specimen shows the heavy black lesions at the crown, in the crown and seed roots and on the stem below and above the crown; these lesions are usually shiny black. Note the white clean tissues of the healthy plant.

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Root Diseases of Cereals

Cereals may be affected by three types of root diseases that are commonly called root rot. All three types are of great economic importance. Types of root rot, crops affected, organisms involved, and the sources of infection, are given in the following table.

Root rot	Crops	Cause	Sources
Common	Wheat, Barley, Rye	*Helminthosporium sativum*, *Fusarium culmorum* and other species of *Fusarium*	Soil and seed
Common	Oats	*Fusarium culmorum* and other species of *Fusarium*	Soil and seed
Take-all	Wheat, Barley, Rye	*Ophiobolus graminis*	Soil
Browning	Wheat	*Pythium* spp.	Soil

Common Root Rot

Importance -- Common root rot is of widespread occurrence in Western Canada. Losses have been estimated at various times to average between five and twelve per cent. Individual fields may have much higher losses.

Symptoms -- Common root rot in wheat, barley and rye crops is most likely to be first noticed shortly after heading. The injury at this time resembles drought damage with which it is usually associated. Large or small patches of unthrifty plants may be noticed. Diseased plants are slightly shorter than healthy plants and frequently show brown and dead lower leaves. A close examination of individual plants is necessary to determine the amount of disease.

Evidence of common root rot, however, may be seen on plants in the seedling stage. In June infection spots (lesions) may be noticed mainly at the base of the leaf near the surface of the soil; in fact, most infections come from spores or mycelial fragments in or on the soil surface. The spots are light to dark brown in color and vary in size. They may be an inch or more long and may extend part way or completely around the stem. At this time the invasion is not deep and rarely penetrates beyond the tissues of the leaf sheath.

Lesions continue to appear during July and develop at the base (crown) of the plants. They are very noticeable while the plants are green and vigorous just before heading. A close examination of a severely infected plant at this stage will reveal extensive lesions at the crown. The lower parts of leaves, tiller buds, crown roots, and the internodes below and above the crown, may show varying degrees of brownish discoloration (rot) in their tissues. The lesions are very distinct at this time.

In the later stages, through July and August, diseased plants reveal distinct lesions at the crown as described above. The rotted crown and crown roots can be readily seen if the dead leaves and some tillers are torn away from the crown. Lesions on the internode below the crown (the thin internode between the crown and seed) are good indications of infection. At this stage plants showing severe lesions at the crown will also have many dead leaves. The lower leaves die first. The injury at the crown can best be determined by cutting through the crown and crown roots (see illustration) with a sharp knife.

Weather conditions -- Common root rot will spread and develop rapidly in wet warm weather, although under these conditions the crop may not show much injury. Most damage, however, follows a spell of hot, dry weather shortly after heading. In crops on light lands where soil moisture is limited, the fungus devel-

ops rapidly and destroys crown roots as well as invading adjacent internodes. Consequently, most damage from common root rot occurs when a good growing period is followed by hot weather and low soil moisture.

Cereal crops sometimes dry out during a period of hot weather. The leaves turn brown and die. This occurrence, which may be rather sudden, is sometimes referred to as "firing". Common root rot is frequently associated with this drought injury and in such instances the typical crown lesions will be found. In drought injury alone, however, no severe lesions are found at the crown.

Prematurity blight -- At the time of heading, or just before the crop comes into head, some plants are completely blighted. This condition may be found in all cereals. Bleached, dead plants are particularly noticeable when the crop is still green. This form of common root rot is called "prematurity blight" and is sometimes mistaken for take-all.

Control -- Most infections come from the soil. Spores are produced on stubble from infected crops and are spread through and over the soil by cultivation, rains, and wind. Spores or mycelium at or near the surface of the soil are most effective in causing infections. Those below seed level usually are unable to infect the plants. Control of common root rot, therefore, requires careful attention to cultural practices.

(1) Practice spring plowing to turn down the stubble and contaminated surface soil, and follow with seeding immediately.

(2) Rotate cereal crops with noncereal crops such as flax, rape or legumes.

(3) Rotate wheat or barley crops with oats.

Seed treatments are generally of little value for the control of common root rot. However, if seed containing black point or smudged kernels is used, it should be treated with a good mercury dust or liquid fungicide as recommended for smut control.

Take-all Root Rot

Importance -- Take-all occurs chiefly in the semiwooded areas of the black soil zones. The disease may be found in a few scattered plants in small patches or entire fields. Losses of 20 to 30 per cent in individual fields are not uncommon.

Symptoms -- Take-all is a conspicuous disease and affected plants are easily recognized in stages from heading to maturity. Diseased plants are bleached and, when numerous or present in large patches, they can be noticed at a distance. A close examination of affected plants will show stunting as well as bleaching. Sometimes the head does not form; the plants pull easily from the soil and reveal distinctly black, sometimes quite shiny, rotted crowns and crown roots. The internode between the crown and the seed roots may also be blackened. A black decay is usually dominant although shades of dark brown, chiefly at the base of the leaves, may also be seen. The seed will be severely shrivelled. Take-all may be confused with prematurity blight mentioned under common root rot; however, the severe bleaching, black rotted crowns and roots and shrivelled seed found in take-all sets it apart from similar blights (see illustration).

Infections on the roots of seedlings are characterized by a distinct black type of lesion. Diseased seedlings may be overlooked unless they are in patches.

Weather conditions -- The take-all fungus completes its growth on the stubble from an infected crop; rainy periods in the fall and spring favor its development. Weather conditions through the crop season, however, do not greatly influence the occurrence of take-all, although in extremely dry weather the disease is confined to the seed roots.

Control -- Take-all may be troublesome if wheat follows wheat for several years. It commonly appears in wheat crops after native or cultivated sod land has

been broken. It can usually be controlled by growing a resistant crop such as oats or by keeping the land fallow for a year. To control take-all, growers should observe these rules:

(1) Use a rotation such as wheat, oats, wheat, fallow, followed by a suitable rotation for the district.

(2) Maintain soil fertility.

Browning Root Rot

Importance -- Browning root rot is primarily a disease of wheat and almost invariably appears only in the crop on fallow land. This disease was once common in crops on dark brown or black heavy soils and caused reductions in yield up to 10 bushels per acre. It also delayed maturity of crops by a week to ten days and sometimes exposed wheat to additional losses from stem and leaf rusts and frost. Control measures have reduced the disease to one of minor importance.

Symptoms -- Unlike the other two diseases described above, browning root rot is conspicuous in the seedling stage. It generally appears in large patches that sometimes spread over almost the entire field. In such cases it is easily seen at a distance and is rather alarming in appearance. The lower leaves of the seedlings turn brown and die. Diseased plants are greatly retarded and for this reason the areas in which they occur become conspicuous as the crop matures. These areas are usually characterized by late, single-stemmed plants. Unless chemical control has been practiced the areas will also contain many weeds.

An examination of the seedlings will show that there are no lesions on the stems or leaves. The infection will be found only on the roots. The lesions on the tiny roots at this stage of growth are difficult to see. Later, when crown roots first appear, pinkish, water-soaked lesions are usually noticeable at the tips of these roots.

Weather conditions -- The particular soil fungus that causes browning root rot can develop well only in soil of ample moisture content. A spring of more than average rainfall increases root infections, and a subsequent dry spell hastens wilting and dying of the lower leaves.

Control -- Browning root rot occurs when soil nutrition is unbalanced, therefore the following recommendations are given.

(1) Use phosphate fertilizer as recommended for the district concerned.

(2) Sow seed in a firm seedbed.

(3) Work into the soil stubble or other organic matter.

(4) Avoid burning the stubble.

A partial summer fallow has been found beneficial in some districts. Partial summer fallow is land on which a crop of oats, barley, or clover is grown until about midsummer; after the crop is harvested for hay or plowed down, the land is kept fallow. Occasionally the fallow is maintained for the first half of the season then followed by a crop.

Thatcher wheat shows some resistance to browning root rot.

Injuries Confused with or Aggravating Root Rot

Damage to crops caused by alkali, drought, soil drifting, weed sprays, wireworms, and wheat stem maggots, is frequently mistaken for root rot injury and, conversely, root rots may be mistaken for other troubles. Very often some of these troubles are associated with root rot injury.

Enquiries

When information or advice is required, specimens accompanied by a brief account of the trouble should be sent to the nearest agricultural representative or authority. Plants should be carefully removed from the soil so that part of the root system remains attached, and specimens should be dried before they are mailed.

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